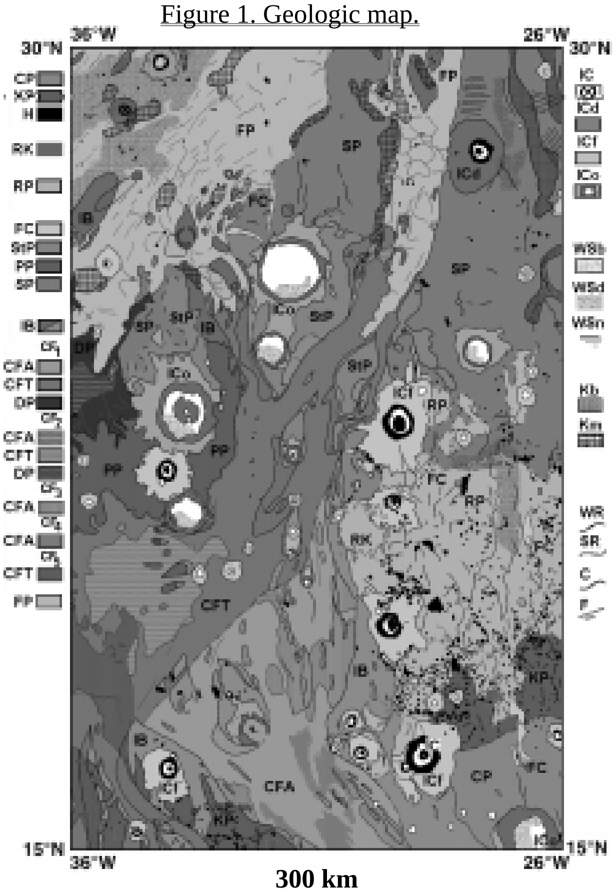
GEOLOGIC MAPPING OF THE MOUTH OF ARES VALLIS, MARS.

A.G. Marchenko, A.T. Basilevsky (Vernadsky Institute, Russian Academy of Sciences, Kosygin St., 19, Moscow, Russia 117975); G. Neukum, E. Hauber, H. Hoffmann, A.C. Cook, (DLR Institute of Planetary Exploration, 12489, Berlin, Germany)

Introduction. Ares Vallis is one of the largest martian valleys. These valleys have remained geological enigmas ever since they were discovered during the Mariner 9 mission. The future Mars Pathfinder landing site is planned to be within the mouth of Ares Vallis [6].The interpretation of the Pathfinder data will depend much on the understanding of regional and local geology. We studied 320 low and medium resolution Viking Orbiter images of the area between 15°N and 30°N, 26°W and 36°W. Impact craters were counted on 48 medium and 7 low resolution images. The digital elevation model has been made for the southern part of the area based on Viking image stereometric measurements. As a result of the work, the 1:2M geologic map (Figure 1) has been made [10].

Description of the units from older to younger. ***PLATEAU MATERIALS:*** *Densely Cratered Plateau Material(CP).* Middle Noachian Impact breccia and Hesperian-Noachian lava flows [12] partly eroded first, by Late Noachian large-scale erosion [13], then probably by the shallow broad flow at Middle-Late Hesperian, and by the Hesperian-Early Amazonian valley-forming flow(s). For the results of crater counting see Figure 2.

Figure 1. Geologic map.



Knobby Plateau Material (KP). A part of the *CP* but the material is highly degraded by earliest erosion [13], probably partly buried by the *RP* and eroded by valley-forming flow(s).

Hills Material (H). Remnants of the *CP* that underwent the same events as the *KP* [12,13].

MATERIAL OF RINGS OF KNOBS (RK): Remnants of large old crater rims [12,13]. Their existence implies [4] that the highland material may be preserved as far north as 30°N beneath the material of the younger plains.

RIDGED PLAINS MATERIAL (RP): Hesperian [15] or Hesperian-Noachian volcanic plains [12]. The *RP* was eroded during two main episodes of outflow channeling and probably covered by fluvial deposits. During the first stage of flooding the meridional *FC* formed by broad shallow flow. In the north the *RP* probably was covered by earlier fluvial deposits (*StP* and *SP*). After the stage of deposition the channels cut down through the *RP*.

OLDER FLUVIAL MATERIALS: *Faint Channels and Islands Materials (FC).* Fluvial deposits within elongated shallow troughs and small islands which were formed probably by the first stage of flooding at Middle-Late Hesperian.

Spotted Plains Material (StP). Fluvial (probably delta) deposits of the same age. The plains have faint features reminding alases of *PP* (see below) and few degraded craters' rims which are widely presented within *SP*.

Pitted Plains Material (PP). Material probably created by fluvial deposition of water-rich material at approximately the same time. Kuzmin and Greeley [8] suggest that this material is delta deposits of outflow valleys. The PP is characterized by possible alases [3] and extremely high thermal inertia [2] what might mean a presence of coarse sand to pebbles [5] particle sizes of the deposits primary or due to eolian deflation.

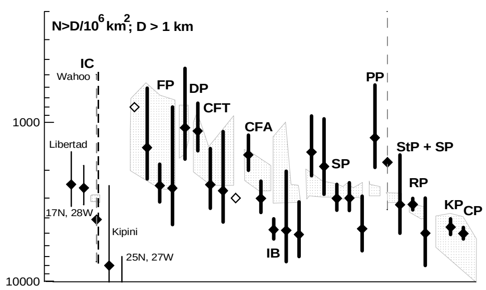
Smooth Plains Material (SP). These thin deposits more likely might have been formed by lacustrine sedimentation during late Hesperian, if a paleolake existed in the delta area of the channels [14]. Thickness of deposits according to diameters of preserved crater rims is 100-200 m.

The oldest fluvial deposits (*StP*, *PP* and *SP*) were eroded by channel-forming flow(s) during the subsequent stage(s) of fluvial activity.

Younger Fluvial Materials: *Islands and Benches Materials (IB).* Materials of eroded units and Hesperian-Early Amazonian catastrophic flood sediments. The islands and benches normally have terraces or steep slopes south of approximately 25°N (e.g. about 7-8 terraces at 20°N, 30.5°W [8] and four terraces at 23°N, 30°W) and gentle slopes in the north. The southern part of this unit formed when the stream cut down [1]. Concerning the northern *IB*, they may be formed in the region of deposition, or weak erosion, at the channels' mouth.

Channel Floor Materials (CF). Late Hesperian-Early Amazonian catastrophic flood sediments on floor of the erosional valleys [11]. By considering morphology and crater counting, the *CF* unit could be subdivided into three sub-units with probably different stratigraphic positions: *CF of Ares Vallis Material (CFA), CF of Tiu Vallis Material (CFT),* and *Dark Plains Material (DP).* These materials are present in the form of five morphological types of the channel-floor plains: 1) smooth plains with a few grooves (CF_1), 2) plains with many knobs (CF_2), 3) plains with many yardang-like ridges (CF_3), 4) plains with etched morphology (CF_4), 5) scabby terrains (CF_5). Different types of plains probably correspond to different hydrodynamic conditions of valley-forming flow(s). However some authors [3, 7, 8] suggest possible surface modification within the *CF* by the post-fluvial eolian deflation, or thermokarst.

Figure 2. Results of crater counts.



Fractured Plains Material (FP): The origin of this Late Hesperian-Early Amazonian material is not clear but it seems to be sedimentary water/ice-rich deposits [9, 13] which flowed backward into channels' mouths from the North. Evidently only some eolian features and impact craters formed later than the *FP*.

Impact Crater Materials: These materials are subdivided into *Fresh Craters' Rims (IC), Dry Ejecta (ICd), Fluidized Ejecta (ICf)* and *Old Craters' Rims (ICo)* on the map. The majority of secondary craters are within the N-S trending band from 18°N to 24°N. The proper stratigraphic position may be given only for the largest craters. As the ejecta of the crater Libertad covers the *FC* and is eroded by channel-forming flow, so it formed between these two stages of flooding.

Eolian Features Materials (EF): The material is subdivided into *Bright (WSb)* and *Narrow Wind Streaks (WSn),* and *Dark Streaks and Spots (WSd)* on the map. The eolian features post-date the terrains they are on.

Possible Geologic History of the Region. At the end of Noachian the old *Cratered Plateau* was partly destroyed, forming the *Knobby Plateau, Hills* and *Rings of Knobs* units. It was the first stage of large-scale erosion in this region. Then low areas between hills on eroded plateaus were buried by probably volcanic *Ridged Plains*. The Wahoo crater was formed. Fluvial activity probably began as sheetwash erosion during the formation of a first valley and *Spotted Plains*, *Pitted Plains*, and *Smooth Plains* deposition at Middle-Late Hesperian. During the next Late Hesperian-Early Amazonian episodes of fluvial activity Ares and Tiu Valles cut down through the old deposits and the volcanic plains of *Cratered Plateau, Knobby Plateau,* and *Ridged Plains.* The last flood was probably from Tiu Vallis. After this thermokarst and related local fluvial activity might be within the *Pitted Plains*, *Spotted Plains,* and *Dark Plains* units. The *Fractured Plains* probably were formed during the last episode of delta, or lacustrine deposition, along terminations of Ares and Tiu Valles and then the surface was reworked by specific processes involving flowing of the viscous material [13]. *Islands* and *Channel Floor* materials were locally buried by the *Fractured Plains* material. Eolian activity, mass-movement processes and impact cratering were being active at all times.

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